Observation of photonic bands of 1D photonic crystals by irradiating an evanescent wave from a high-energy electron beam

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Smith-Purcell radiation (SPR) was observed from a two-dimensional photonic crystal (PC)[1]. However, peculiar light emission was also observed. The slope of the dispersion relations between energy and wavenumber was smaller than the light line. In this study, we investigate the mechanism of the peculiar light emission from a PC. To simplify the analysis, one-dimensional PCs were fabricated by cylinders of teflon (dielectric constant: ε = 2.05), fused quartz (ε = 4.41) and aluminum. The dispersion lines of SPR and the peculiar light emission were observed from the PCs of teflon and fused quartz, while only the lines of SPR were observed from that of aluminum. The photonic band was calculated by the Korringa-Kohn-Rostoker formalism on the basis of vector cylindrical harmonics. The calculated curves showed good agreement with those of the experimental results. From these facts, it is inferred that the peculiar light emission is related with the photonic band.

[1] K. Yamamoto et al., *Phys. Rev. E***69**, 045601 (2004)